SPECIFICATION

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METHOD AND APPARATUS FOR RAILCAR DATA ACQUISITION AND COMMUNICATION

Background of Invention

[0001] The present invention relates generally to the field of data acquisition and communication and specifically to the use of electronic equipment to communicate railcar data among railcars, locomotives, and railway personnel.

[0002] In a growing number of applications, railcars are being equipped with electronic communications equipment establishing a data link among railcars, locomotives, and railway personnel. One typical application is an electronic braking system. Rather than relying on brake pipe pressure to initiate railcar braking, electronic braking are transmitted to the railcar's electronic braking system thereby enabling a wider variety of braking strategies useful, for example, in managing slack in the train.

[0003] The acceptance by the railroad industry of such railcar electronic communications equipment coupled with the advent of inexpensive local area network (LAN) equipment for acquiring data inside the railcar presents numerous opportunities for communicating new types of railcar data. For example, temperature, pressure, or humidity may be communicated as an aid to monitoring the quality of environmentally sensitive payloads; payload weight, tank level, or bin level may be communicated as an aid to payload management; vibration, bearing temperature, wheel speed, or wheel revolutions may be communicated as an aid to railcar preventive maintenance; and railcar identity may be communicated as an aid to all aspects of railcar management.

Summary of Invention

[0004] The opportunities described above are addressed, in one embodiment of the

present invention, by an apparatus for railcar data acquisition and communication, the apparatus comprising: a data acquisition module adapted for acquiring railcar data from a railcar and generating acquired data; and an electronic transmitter adapted for receiving the acquired data, deriving transmitted data from the acquired data, and transmitting the transmitted data.

Brief Description of Drawings

[0005] These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

[0006] The Figure illustrates a block diagram in accordance with one embodiment of the present invention.

Detailed Description

[0007] In accordance with one embodiment of the present invention, the Figure illustrates a block diagram of an apparatus 100 for railcar data acquisition and communication, wherein apparatus 100 comprises a data acquisition module 110 and an electronic transmitter 120. Data acquisition module 110 acquires railcar data from a railcar 130 and generates acquired data; electronic transmitter 120 receives the acquired data, derives transmitted data from the acquired data, and transmits the transmitted data to an electronic receiver (not shown) external to railcar 130.

[0008] Data acquisition module 110 comprises any electrical or electronic devices or combination thereof capable of performing the indicated functions. Exemplary embodiments of data acquisition module 110 may comprise, singly or in combination: sensing components including, without limitation, analog sensors, digital sensors, and analog-to-digital (A/D) converters; computational components including, without limitation, microprocessors, microcontrollers, single-chip digital signal processors (DSPs), large-, medium-, and small-scale integrated circuits (LSI, MSI, SSI), application specific integrated circuits (ASICs); and communication components including, without limitation, universal asynchronous receiver/transmitters (UARTs) and universal synchronous/asynchronous receiver/transmitters (USARTs).

[0009] As defined herein, "railcar data" denotes any characteristic or property of railcar 130 that may be of interest to owners or operators of railcar 130; examples of railcar data include, without limitation, temperature, pressure, humidity, payload weight, tank level, bin level, vibration, bearing temperature, wheel speed, wheel revolutions, and railcar identity.

[0010] Railcar 130 comprises any vehicle capable of traveling on railroad tracks; examples of railcar 130 include, without limitation, box cars, ore cars, flat cars, tank cars, and locomotives.

[0011] Electronic transmitter 120 comprises any electrical or electronic devices or combination thereof capable of performing the indicated functions. Exemplary embodiments of electronic transmitter 120 may comprise, singly or in combination: computational and communication components similar to those of data acquisition module 110; transmitting components employing, for example, electrical conduction or electromagnetic radiation including, without limitation, radio frequency (RF) radiation and infra-red (IR) radiation; and encoding components implementing signal encoding schemes including, without limitation, amplitude modulation (AM), frequency modulation (FM), on-off keying (OOK), amplitude shift keying (ASK), and frequency shift keying (FSK).

[0012] In a more detailed embodiment in accordance with the embodiment of the Figure, electronic transmitter 120 wirelessly transmits the transmitted data. As used herein, "wirelessly transmitting" refers to the use of electromagnetic radiation for data transmission. Examples of electromagnetic radiation include, without limitation, RF and IR radiation.

[0013] In another more detailed embodiment in accordance with the embodiment of the Figure, data acquisition module 110 comprises a single-wire interface 140. Single-wire interface 140 converts single-wire data to acquired data. As used herein, "single-wire data" refers to any data encoded by any communication scheme utilizing only one wire to carry both power and signal and, optionally, a signal return wire. True single-wire communication results if, for example, chassis ground is used for the signal return path. Examples of single-wire interface 140 include, without limitation, the DS2480 Serial 1-WIRE ® Line Driver, the DS2480B Serial 1-WIRE ® Line Driver with

Load Sensor, and the DS2490 USB (Universal Serial Bus) to 1-WIRE ® Bridge Chip (1-WIRE ® is a trademark of Maxim Integrated Products, Sunnyvale, California, hereinafter, "Maxim"). As used herein, all part numbers beginning with "DS" refer to devices manufactured by Maxim.

[0014] In another more detailed embodiment in accordance with the embodiment of the Figure, data acquisition module 110 further comprises a single-wire identification device 150. Single-wire identification device 150 converts identification data to single-wire data. Examples of single-wire identification device 150 include, without limitation, the DS2401 Silicon Serial Number, wherein the identification data comprises a 48-bit serial number, and the DS2422 1-kbit 1-WIRE ® RAM (random access memory) with Counter and DS2423 4-kbit 1-WIRE ® RAM with Counter wherein the identification data may comprise, for example, tare weight, manufacturer's name, repair data, service data, or combinations thereof.

[0015] In another more detailed embodiment in accordance with the embodiment of the Figure, data acquisition module 110 further comprises a single-wire thermometer 160. Single-wire thermometer 160 measures a temperature of the railcar 130 or of a payload and converts the temperature to single-wire data. Examples of single-wire thermometer 160 include, without limitation, the DS18S20 1-WIRE ® Digital Thermometer.

[0016] In another more detailed embodiment in accordance with the embodiment of the Figure, data acquisition module 110 further comprises a single-wire counter 170 and a wheel shaft encoder 180. In operation, single-wire counter 170 counts data pulses to yield a data pulse count and converts the data pulse count to single-wire data while wheel shaft encoder 180 generates the data pulses as a function of revolutions of a wheel of railcar 130. Examples of single-wire counter 170 include, without limitation, the DS2422 1-kbit 1-WIRE ® RAM (random access memory) with Counter and DS2423 4-kbit 1-WIRE ® RAM with Counter. Examples of shaft encoder 180 include, without limitation, incremental optical shaft encoders and incremental magnetic shaft encoders.

[0017] In another more detailed embodiment in accordance with the embodiment of the Figure, data acquisition module 110 further comprises a single-wire analog interface

190. Single-wire analog interface 190 converts an analog sensor signal from an analog sensor 200 to single-wire data; examples of single-wire analog interface 190 include, without limitation, the DS2450 1-WIRE ® Quad A/D Converter. Examples of analog sensor 200 include, without limitation, load cells, vibration sensors, level sensors, pressure sensors, and humidity sensors.

[0018] As used herein, "load cell" denotes any device or system for measuring a force; load cells are typically used to measure the weight of a payload and typically comprise strain gauges mounted on structural members with known elastic properties. "Vibration sensor" denotes any device or system for measuring the motion of a surface; embodiments of vibration sensors include, without limitation, accelerometers and optical interferometers. "Level sensor" denotes any device or system for measuring the height of a substantially horizontal surface relative to a reference height; level sensors are typically used to measure the height of the free surface in a storage bin of dry material, or the free surface of a storage tank of liquid material. "Pressure sensor" denotes any device or system for measuring either an absolute or a gauge pressure of a liquid or gas. "Humidity sensor" denotes any device or system for measuring the moisture content of a gaseous atmosphere, typically the moisture content of ambient air.

[0019] In another more detailed embodiment in accordance with the embodiment of the Figure, data acquisition module 110 further comprises a touch pad interface 125. Touch pad interface 125 communicates the acquired data to an external touch pad (not shown). The external touch pad provides an alternative interface for railcar owners or operators to retrieve the data acquired by data acquisition module 110. Examples of touch pad interface 125 include, without limitation, the DS1991 MultiKey IBUTTON ™ device. (IBUTTON ™ is a Maxim trademark.) Examples of the external interface include, without limitation, the DS9092 family of IBUTTON ™ probes.

[0020] In a still more detailed embodiment in accordance with the embodiment of the Figure, touch pad interface 125 is further adapted for receiving touch pad data from a second external touch pad not shown. In some embodiments, the second external touch pad is used to provide operator identity information enabling data acquisition module 110 to restrict data access only to authorized personnel.

[0021] In another embodiment in accordance with the embodiment of the Figure, a system 210 comprises railcar 130 and apparatus 100.

[0022] While only certain features of the invention have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.